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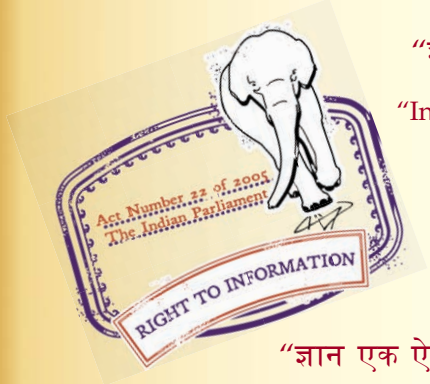
IS 7052 (1973): Test code for power maize shellers [FAD 20: Agriculture and Food Processing Equipments]



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"Knowledge is such a treasure which cannot be stolen"

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IS : 7052 - 1973
(Reaffirmed 2012)

Indian Standard

TEST CODE FOR POWER MAIZE SHELLERS

UDC 631·355·4

INDIAN STANDARDS INSTITUTION
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110001

January 1974

Indian Standard

TEST CODE FOR POWER MAIZE SHELLERS

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(*Continued on page* 22)

Indian Standard

TEST CODE FOR POWER MAIZE SHELLERS

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 28 September 1973, after the draft finalized by the Agricultural Machinery and Tractors Sectional Committee had been approved by the Agricultural and Food Products Division Council.

0.2 Power maize shellers are being extensively manufactured and used in the country for separation of grains from cobs. This test code is a guide for evaluating objectively the performance and constructional durability of shellers. This code, covering type tests as well as routine tests, is also intended to help the manufacturers to develop, and various purchasing agencies to select, suitable power maize shellers to meet their requirements.

0.3 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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1. SCOPE

1.1 This code prescribes method of testing of power maize shellers to evaluate their performance and durability.

2. TERMINOLOGY

2.0 For the purpose of this standard, the following definitions shall apply.

2.1 Clean Grain — Shelled grain free from refractions [*see* IS : 4333 (Part I)-1967†].

2.2 Cleaning Efficiency — Clean grains (*see* **2.1**) received at the specified grain outlet(s) with respect to total grain received at grain outlet(s) expressed as percentage by weight.

*Rules for rounding off numerical values (*revised*).
†Methods of analysis for foodgrains: Part I Refractions.

2.3 Composite Sample — The sample of the grain, husk and shelled cobs formed by combining and blending the primary samples (*see* **2.10**).

2.4 Concave Clearance — The maximum clearance between cylinder and concave.

2.5 Feed Rate — The weight of the cobs fed into the sheller per unit time.

2.6 Final Sample — The sample drawn from the composite sample (*see* **2.3**) for analysis.

2.7 Input Capacity — The maximum feed rate at which the power requirement is minimum and total losses and efficiencies are within the specified limits (*see* **5.1**, **5.2** and **5.3** of IS : 7051 - 1973*).

2.8 Output Capacity — The weight of the grains received at the specified grain outlet(s) when collected at input capacity (*see* **2.7**).

2.9 Power Maize Sheller — A machine operated by a prime mover (*see* **2.11**) to separate the grains from cobs and also to remove the husk from grains.

2.10 Primary Sample — The weight of the grain, husk and shelled cobs taken from the outlets for a specified period of time.

2.11 Prime Mover — An electric motor or engine or tractor used for running the sheller.

2.12 Routine Tests — Tests carried out on each sheller to check the requirements which are likely to vary during production.

2.13 Screen Pitch — Inclination of screen with the horizontal plane in degrees.

2.14 Shelling Efficiency — Percentage by weight of shelled grains from all outlets of the sheller with respect to total grain input.

2.15 Sieve Clearance — The maximum vertical distance between two successive sieves.

2.16 Total Loss — The sum of the following losses in a sheller expressed in percentage.

2.16.1 *Blown Loss* — The clean grain (*see* **2.1**) lost along with the husk with respect to total grain input, expressed as percentage by weight.

2.16.2 *Cracked and Broken Grain Loss* — Cracked and broken grains from the specified grain outlet(s) with respect to total grain received at outlet(s) expressed as percentage by weight.

*Specification for power maize shellers.

2.16.3 *Sieve Loss* — The clean grain (*see* **2.1**) dropped through the sieve, left over sieve and stuck in the sheller with respect to total grain input, expressed as percentage by weight.

2.16.4 *Unshelled Loss* — Unshelled grain (*see* **2.18**) from all outlets with respect to total grain input, expressed as percentage by weight.

2.17 Type Test — Tests carried out on sheller to prove the conformity with the requirements of relevant standard. These are intended to prove the general qualities and design of a particular type of sheller.

2.18 Unshelled Grain — Grains still in the cobs after the shelling.

3. SELECTION AND SPECIFICATION OF SHELLER FOR TEST

3.1 Selection of Sheller — The maize sheller shall be taken from the series production by the testing authority with the agreement of the manufacturer.

3.2 Specification and Other Literature — The manufacturer shall supply all literature, operational manual and schematic diagram of material flow of the sheller. The manufacturer shall also supply the specification sheet duly filled in as given in Appendix A as well as any further information required to carry out the tests.

NOTE — Operational manual shall include maintenance and adjustments schedule and safety precautions.

4. TESTS

4.1 Type Tests

4.1.1 *General*

a) Checking of specification (*see* **6.1**)
b) Checking of material (*see* **6.2**)
c) Visual observations and provision for adjustments (*see* **6.3**)

4.1.2 *Test at No Load*

a) Power consumption (*see* **7.1**)
b) Visual observations (*see* **7.2**)

4.1.3 *Test at Load*

a) Short run tests (*see* **8.1**):
   1) Total losses [*see* **8.1.8** (f)]
   2) Shelling efficiency [*see* **8.1.9** (a)]
   3) Cleaning efficiency [*see* **8.1.9** (b)]

4) Power consumption (*see* **8.1.10**)
5) Input capacity (*see* **8.1.11**)
6) Output capacity (*see* **8.1.12**)
7) Corrected output capacity (*see* **8.1.13**)
8) Visual observations (*see* **8.1.4.6**)

b) Long run test (*see* **8.2**)

4.2 Routine Tests

4.2.1 *Essential*

a) Visual observations and provisions for adjustments (*see* **6.3**)
b) Test at no load (*see* **7.1** and **7.2**)

4.2.2 *Optional*

a) Checking of specification (*see* **6.1**)
b) Checking of material (*see* **6.2**)

5. PRE-TEST OBSERVATIONS

5.1 Determination of Grain Ratio in Cobs — Take ten samples of the cobs at random. Each sample shall be not less than one kg in weight. Separate the grain from the cobs manually for each sample. Take the weight of grain and shelled cob separately for each sample, and calculate their ratio. The average of the ten samples shall be taken as grain and shelled cob ratio.

5.2 Moisture Content of Grain — Take suitable samples of grain (*see* **5.1**) and test them in accordance with IS : 4333 (Part II)-1967* for moisture determination.

5.3 Running-in and Preliminary Adjustments — The sheller shall be new and run-in before commencing the test by the manufacturer in accordance with the instructions and in collaboration with the testing authority for at least one hour. The adjustments for the speed of different shafts, concave clearance, speed of the prime mover, screen pitch, etc, shall be done according to manufacturer's recommendations.

6. GENERAL TESTS

6.1 Checking of Specification — Check all the dimensions and specification mentioned by the manufacturer (*see* **3.2**) and record the data in *pro forma* as given in Appendix A.

*Methods of analysis for foodgrains: Part II Moisture.

6.2 Checking of Material — Check the material for all components and record the data in *pro forma* as given in Appendix B.

6.3 Visual Observations and Provisions for Adjustments — Record the observations and adjustments according to Appendix C.

7. TEST AT NO LOAD

7.1 Power Consumption

7.1.1 Install the sheller on level and preferably on hard surface and set the clearances, screen pitch, etc, in accordance with manufacturer's recommendations. Use electric motor of appropriate power, duly fitted with an energymeter for running the sheller.

7.1.2 Run the sheller at no load for at least half-an-hour at the specified revolution of shelling unit and record the readings of the energymeter at interval of 5 minutes. The difference between two consecutive readings shall give power consumption for 5 minutes. Calculate power consumption at no load for one hour.

7.1.3 Record the data according to item (1) of Appendix D.

7.2 Visual Observations — During and after completing power consumption test (*see* **7.1**), the observations given in item (2) of Appendix D shall be made visually and recorded.

8. TEST AT LOAD

8.1 Short Run Tests

8.1.1 Install the sheller on level and preferably on hard surface and set the clearances, screen pitch, etc, as per manufacturer's recommendations.

8.1.2 Take sufficient quantity of cobs of the same variety free from plant leaves, stalk, etc. The cobs should, as far as possible, be of the same size. The moisture content of the grain shall be 10 to 18 percent.

8.1.3 *Attachment of Prime Mover and Sheller* — Attach the sheller with a suitable prime mover, preferably electric motor. An energymeter or some form of transmission dynamometer shall be fitted. The power delivered to the sheller may be supplied in following ways:

a) Direct coupling the prime mover with the main axle of the sheller, and

b) Connecting the prime mover with the help of flat or V-belt and pulleys with the main axle of the sheller.

In case of (a), the power delivered to the sheller would be the power output of the prime mover; whereas in case of (b), the allowances for flat belt and V-belt drive losses may be taken as 6 and 3 percent respectively.

8.1.4 *Operation and Collection of Data* — Operate the sheller at the specified speed of the shelling unit for one hour at a feed rate 50 percent of the specified value by the manufacturer.

8.1.4.1 During the run period collect the following samples and data:

a) Four sets of primary samples from grain, cobs and husk outlet for a period of two minutes for each set; and

b) Record the speed of main shaft by a revolution counter or an accurately calibrated tachometer. The reading of energymeter or dynamometer shall also be taken at an interval of 15 minutes.

8.1.4.2 At the end of one hour feeding, run the sheller idle for some time, so that practically the entire material already fed comes out. At the end of the test, collect the material dropped through sieve, retained on sieve, the material stuck in the sheller and the grain received at grain outlet(s).

8.1.4.3 Repeat the test given at **8.1.4** for minimum of three times at various feed rates covering the maximum feed rate.

8.1.4.4 Conduct the above test at feed rate which has been determined as input capacity (*see* **8.1.11**) at the following shelling unit speeds:

a) Speeds about 10 and 20 percent more than specified speed, and

b) Speeds about 10 and 20 percent less than specified speed.

8.1.4.5 Record the data according to Appendix E.

8.1.4.6 *Visual observations* — During and after the run tests, inspect the sheller visually, and record the observations according to Appendix E.

8.1.5 *Preparation of Composite Sample* — The primary samples [*see* **8.1.4.1** (a)] collected at a particular feed rate shall be thoroughly mixed and blended to constitute a homogenous composite sample for different outlets. The samples collected at sieve underflow, overflow and stuck in sheller should also be mixed thoroughly to form a composite sample.

8.1.6 *Selection of Final Sample* — Take one kilogram of final sample from each composite sample (*see* **8.1.5**) of different outlets. If it is not possible to get one kilogram sample at husk outlet, take total composite sample as a final sample.

8.1.7 *Analysis of Final Sample* — Analyze the final sample (*see* **8.1.6**) obtained at different outlets for different feed rates by picking with hand separately for the following and record the data according to Appendix F:

a) Cracked and broken grain,
b) Refractions,
c) Unshelled grain, and
d) Clean grain.

NOTE — Analysis for cracked and broken grains shall be made only from the samples taken at specified grain outlet(s).

8.1.8 *Determination of Total Losses*

a) Total grain input = Feed rate × Grain content (*see* **5.1**)

b) Percentage of unshelled grain $= \frac{100 \text{ (Quantity of unshelled grain obtained from all outlets in kg)}}{\text{Total grain input in kg}}$

c) Percentage of cracked and broken grain $= \frac{100 \text{ [Cracked and broken grain from specified grain outlet(s) in kg]}}{\text{Total grain received at grain outlet(s) in kg}}$

d) Percentage of blown grain $= \frac{100 \text{ (Quantity of clean grain obtained at husk outlet in kg)}}{\text{Total grain input in kg}}$

e) Percentage of sieve loss $= \frac{100 \text{ (Clean grain obtained at sieve overflow + Sieve underflow + Stuck grain in kg)}}{\text{Total grain input in kg}}$

f) Total losses = Sum of losses obtained at (b), (c), (d) and (e) above

8.1.8.1 Record the data according to Appendix G.

8.1.9 *Determination of Efficiencies*

a) Shelling efficiency = 100 — Percentage of unshelled grains

b) Cleaning efficiency $= \frac{100 \text{ [Clean grain received at grain outlet(s) in kg]}}{\text{Total grain received at grain outlet(s) in kg}}$

8.1.9.1 Record the data according to Appendix G.

8.1.10 *Determination of Power Consumption*

a) In case of energymeter fitted prime mover, the difference between two consecutive readings [*see* **8.1.4.1** (b)] shall give power consumption for 15 minutes. Calculate the power consumption for one hour giving due allowances to type of drive (*see* **8.1.3**).

b) In case of dynamometer fitted prime mover, the average of reading taken shall give the average torque required. Calculate the power requirement by the following formula:

$$\text{Power in kW} = \frac{\text{Torque in kgf. m} \times \text{Speed in rev/min}}{973{\cdot}363}$$

8.1.10.1 Record the data according to Appendix G.

8.1.11 *Determination of Input Capacity* — Select the feed rate at which the total losses [*see* **8.1.8** (f)] and efficiencies (*see* **8.1.9**) are within the specified limits (*see* **5.1**, **5.2** and **5.3** of IS : 7051 - 1973*) and power consumption is minimum. This should be achieved by drawing a curve for losses and efficiencies against various feed rates. Capacity in terms of energy consumed shall be calculated by dividing the capacity by power consumed (**8.1.10**).

8.1.11.1 Record the data according to Appendix G.

8.1.12 *Determination of Output Capacity* — Take the weight of shelled grain received at specified grain outlet(s) and record the data according to Appendix G.

8.1.13 *Determination of Corrected Output Capacity* — To avoid the variation of moisture content of grain and grain ratio, the output capacity as obtained under **8.1.12** should be corrected at 12 percent moisture and 40 percent grain ratio by the following formula:

$$W_1 = \left[W - \frac{W\,(M - 12)}{88} \right] \frac{40}{R}$$

where

W_1 = corrected output capacity,

W = output capacity (*see* **8.1.12**)

M = observed moisture content (*see* **5.2**), and

R = observed grain ratio in percent (*see* **5.1**).

8.1.13.1 Record the data according to Appendix G.

8.2 Long Run Test — Operate the sheller for at least 20 hours which should be covered by continuous run of at least 5 hours. If facilities are available it may be run for 50 hours. Record the major breakdowns, defects developed and repairs made, according to Appendix H.

9. SUMMARY REPORT

9.1 For the guidance of the users, compile a summary report on the *pro forma* as given in Appendix J.

*Specification for power maize shellers.

APPENDIX A

(*Clauses* 3.2 *and* 6.1)

SPECIFICATION SHEET

	To be Filled by	
	Manufacturer	*Testing Station*

1. General:
   a) Make
   b) Model
   c) Type
   d) Year of manufacture
2. Power Unit:
   a) Provision
   b) Type of prime mover
   c) Recommended power, kW or hp
   d) Type of drive
3. Main Drive:
   a) Type
   b) Size of belt
   c) Size of pulley
   d) Diameter of main shaft
4. Shelling Unit:
   a) Type
   b) Constructional features
   c) Diameter
   d) Width
   e) Recommended speed
   f) Number and size of beaters/ projections/bars

	To be Filled by	
	Manufacturer	*Testing Station*

5. Concave:
   a) Type
   b) Diameter
   c) Length
   d) Concave clearance range
   e) Recommended concave clearance
   f) Clearance adjustment provision

6. Sieve:
   a) Type
   b) Number
   c) Total length and width
   d) Effective length and width
   e) Number of holes per cm^2
   f) Size of hole
   g) Sieve clearance
   h) Screen pitch range
   j) Recommended screen pitch

7. Shaker:
   a) Type
   b) Number of strokes per minute

8. Blower:
   a) Number
   b) Type
   c) Number of blades
   d) Size of blades
   e) Diameter
   f) Recommended speed
   g) Recommended air displacement
   h) Provision for changing air displacement

	To be Filled by	
	Manufacturer	*Testing Station*

9. Elevator:
   a) Type
   b) Capacity
   c) Grain spout size
   d) Height above ground level

10. Hopper:
   a) Type
   b) Capacity
   c) Method of feeding
   d) Recommended maximum feed rate

11. Transport:
   a) Type
   *b) Number of wheels
   *c) Size of wheels

12. Fly Wheel Size

13. Overall Dimensions:
   a) Length
   b) Width
   c) Height
   d) Total weight

14. Tools, Accessories and Manuals Provided:

NOTE 1 — The items which are not applicable in a particular sheller shall be crossed while filling.

NOTE 2 — If any other items are provided, their details shall be filled in.

*In case wheels are not provided, details of alternative provision shall be given.

APPENDIX B

(*Clause* 6.2)

MATERIAL OF CONSTRUCTION DATA SHEET

1. Date of Test

2. Material of Construction:

Sl No.	Component	Material	Size	Weight
(1)	(2)	(3)	(4)	(5)
1	Frame			
2	Hoppper			
3	Cylinder/Disc cover			
4	Cylinder/Disc			
5	Beater/Projection/Bar			
6	Concave			
7	Blower			
8	Main shafts			
9	Blower shaft			
10	Fly wheel			
11	Sieve			
12	Shaker			
13	Elevator			
14	Transport wheel			
15	Pulleys			
16	Others			

NOTE 1 — Delete the component which is not applicable to a particular sheller and add if any other component is provided.

NOTE 2 — Col 4 and 5 should be recorded wherever feasible.

Testing Engineer

APPENDIX C

(*Clause* 6.3)

DATA SHEET FOR VISUAL OBSERVATIONS AND PROVISIONS FOR ADJUSTMENTS

1. Observations:
   a) Adequacy of marking of inlet and outlets
   b) Adequacy of marking of direction of rotation of shelling unit
   c) Adequacy of protection of bearings against the ingress of dust
   d) Adequacy of safety arrangements, specially at moving points
   e) Provision for lubrication of moving parts
   f) Provision for belt tightening
   g) Provision for transportation
   h) Provision for easy changing of components requiring frequent replacement
   j) Provision for easy replacement and cleaning of screens
   k) Provision for anti-corrosive coatings
   m) Tightness of bolts and nuts and other fasteners
   n) Balancing of shelling unit
   p) Welding of seams
   q) Other observations
2. Provision for Adjustments of:
   a) Feed rate
   b) Concave clearance
   c) Speed
   d) Screen pitch
   e) Sieve clearance
   f) Air displacement

Testing Engineer

APPENDIX D

(*Clauses* 7.1.3 *and* 7.2)

TEST AT NO LOAD DATA SHEET

1. Power Consumption:
   a) Source of power
   b) Type of drive
   c) Total time of run
   d) Energymeter readings at interval of 5 minutes
   e) Average power consumption for one hour
2. Observations:
   a) Presence of any marked oscillation during operation
   b) Presence of undue knocking or rattling sound
   c) Frequent slippage of belts
   d) Smooth running of shafts in their respective bearings
   e) Any marked unusual wear or slackness in any component
   f) Any marked rise in bearing temperature
   g) Other observations

Testing Engineer

APPENDIX E

(*Clauses* 8.1.4.5 *and* 8.1.4.6)

TEST AT LOAD DATA SHEET

1. Source of Power
2. Power Rating
3. Type of Drive
4. Variety of Maize
5. Grain Ratio
6. Moisture Content
7. Concave Clearance
8. Screen Pitch
9. Sieve Clearance

10. Test Data*

Sl No.	Date	Starting Time	Stopping Time	Duration of Operation	†Speed (rev/min)	Feed Rate (quintal/h)	Power Required (kW) or Fuel Consumed (litre/h)	No. of Primary Samples	Quantity (kg) of Primary Samples from			Total Quantity of Grain at Grain Outlet(s) (kg)	Total Quantity at Sieve Under Flow (kg)	Total Quantity of Material Stuck in Sheller (kg)
									Grain Outlet(s)	Husk Outlet	Shelled Cobs Outlet			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
								i)						
								ii)						
								iii)						
								iv)						

*The data shall be collected for every test conducted on different feed rate.

†Test shall be conducted at specified speed and speeds 10 and 20 percent less and more than specified.

11. Observations:

a) Presence of any marked oscillation during operation
b) Presence of undue knocking or rattling sound
c) Frequent slippage of belts
d) Smooth running of shafts in their respective bearings
e) Frequent clogging of shelling units
f) Frequent clogging of sieve aperture
g) Smooth flowing of material through different components
h) Vibration free running of fan
j) Frequent clogging of grain in elevator unit
k) Any marked rise in bearing temperature
m) Any marked wear, deformation and breakdown
n) Frequent loosening of fasteners
p) Other observations (if any)

Testing Engineer

APPENDIX F

(*Clause* 8.1.7)

DATA SHEET FOR ANALYSIS OF FINAL SAMPLES

Sl No.	Feed Rate	Shelling Unit Speed	Sample from	Weight of			
				Unshelled Grain	Cracked and Broken Grain	Clean Grain	Other Refractions
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
			i) Grain outlet(s)				
			ii) Husk outlet		—		
			iii) Shelled cobs outlet		—		
			iv) Sieve underflow		—		
			v) Material stuck in sheller		—		

Testing Engineer

NOTE — For different feed rate and for different speed of shelling unit use the same *pro forma* as above.

APPENDIX G

(*Clauses* 8.1.8.1, 8.1.9.1, 8.1.10.1, 8.1.11.1, 8.1.12 *and* 8.1.13.1)

DATA SHEET FOR LOSSES, EFFICIENCIES, POWER REQUIREMENT AND CAPACITIES

Sl No.	Item	Test No.									
		1	2	3	4	5	6	7	8	9	10
1	Shelling unit speed										
2	Feed rate quintal/h										
3	Power required, kW										
4	Total grain received at grain outlet(s)										
5	Percentage of unshelled grain										
6	Percentage of cracked and broken grain										
7	Percentage of blown grain										
8	Percentage of sieve loss										
9	Percentage of total loss										
10	Shelling efficiency										
11	Cleaning efficiency										
12	Input capacity, quintal/h										
13	Output capacity, quintal/h										
14	Corrected output capacity, quintal/h										

Testing Engineer

APPENDIX H

(*Clause* 8.2)

LONG RUN TEST DATA SHEET

1. Total Running Time
2. Continuous Running Time
3. Breakdowns in Shelling Unit
4. Breakdowns in Cleaning Unit
5. Breakdowns in Elevating Unit
6. Breakdowns in Body
7. Any Major Repairs Conducted
8. Any Other Observations

Testing Engineer

APPENDIX J

(*Clause* 9.1)

SUMMARY REPORT

1. Name of Manufacturer
2. Model Number
3. Name of Testing Station
4. Variety of Maize Used
5. Grain Ratio
6. Moisture Content
7. Adjustments:
   a) Speed
   b) Screen pitch
   c) Concave clearance
   d) Sieve clearance
   e) Air displacement

8. Power Requirement, kW:
   a) At no load
   b) At load on input capacity
9. Losses, percent:
   a) Cracked and broken grain
   b) Unshelled grain
   c) Sieve loss
   d) Blown loss
   e) Total loss
10. Input Capacity, quintals/h
11. Variation on Input Capacity:
   a) At 10 percent more than specified speed
   b) At 20 percent more than specified speed
   c) At 10 percent less than specified speed
   d) At 20 percent less than specified speed
12. Input Capacity, quintals/kWh
13. Output Capacity, quintals/h
14. Output Capacity, quintals/kWh
15. Corrected Output Capacity, quintals/kWh
16. Any marked Observation Affecting Performance
17. Any Mark Breakdowns
18. Other Observations

Testing Engineer

(*Continued from page* 2)

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Printed at Printograph, New Delhi, India